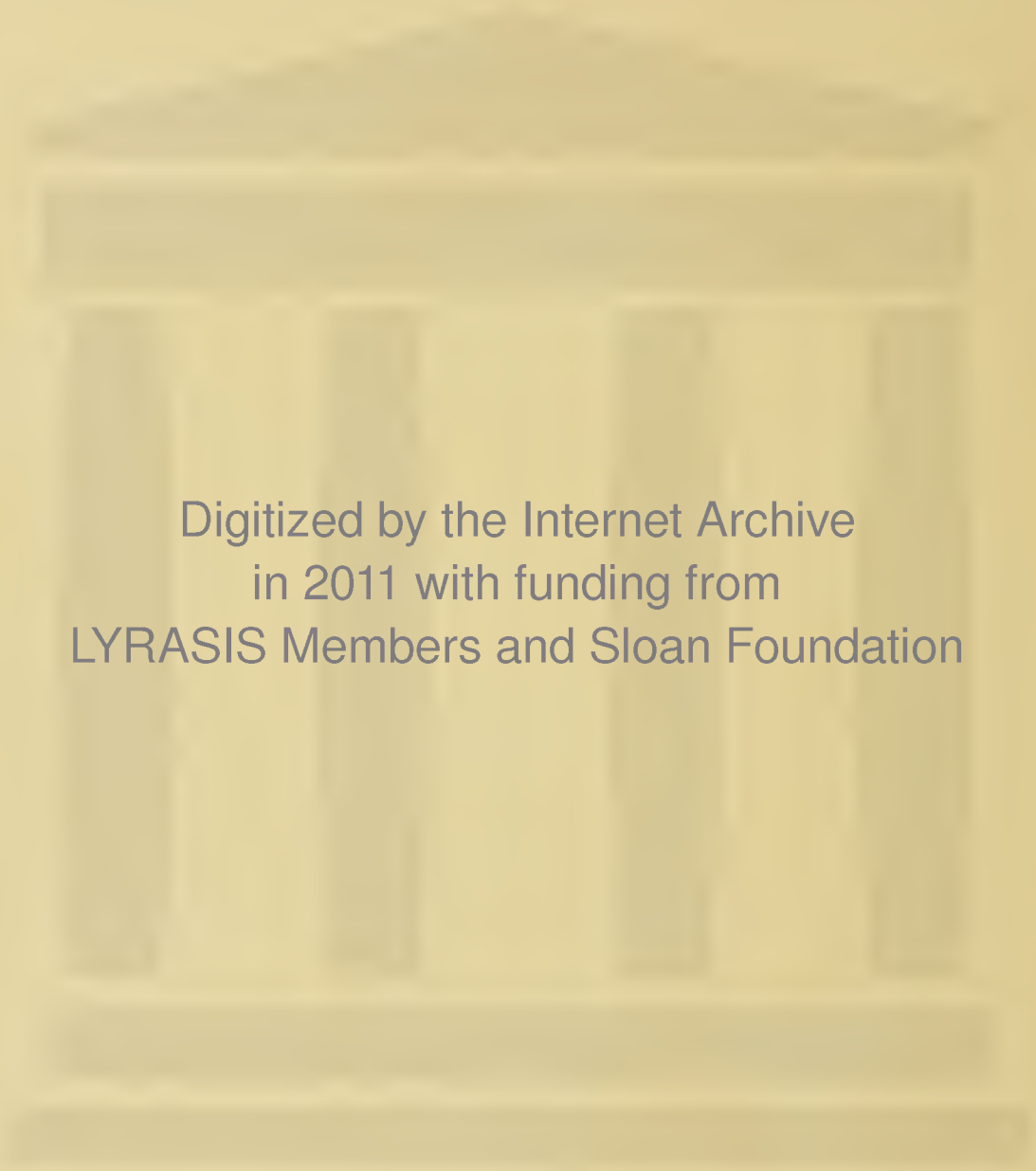
AN ENQUIRY INTO THE AVAILABILITY AND USE OF ATLANTIC MARINE FAUNA AT, OR NEAR, THE MOUTH OF THE ST. JOHNS RIVER, FLORIDA, SUITABLE FOR ILLUSTRATING COURSES IN ZOOLOGY AT FLORIDA SOUTHERN COLLEGE

GLADYS DUNCAN



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Manuscript Thesis

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GLADYS DUNCAN

Submitted in partial fulfillment of the requirements for the degree of Master of Arts in the Graduate School of Florida Southern College

1948

APPROVAL SHEET

READERS:

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ADVISOR:

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Professor Roy S. Kiser

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Foreword

In the following pages the keynote is experience. The results stated, the methods suggested, and the difficulties encountered ---- all are the results of actual, sincere experience.

I am deeply indebted to my friend, Mr. Mithias Rolao (Roland) owner of the shrimp boat, who, through his kindness, made possible the necessary excursions aboard boat; Mr. Tony Souza, the captain of the boat from which the specimens were taken; and Ernest Lawrence, the colored deck hand or striker who helped sort out many of the specimens from the net hauls.

From the faculty of Florida Southern College, I acknowledge the kind and generous assistance rendered by Dr. Donald A. Thompson, Dean of the Graduate School, and Dr. Roy S. Kiser of the Zoology Department who continually encouraged me in the project.

Gladys Duncan

AN OUTLINE

of

A PROJECT

(as Partial Fulfillment of the Requirements for the Degree of Master of Arts)

GLADYS DUNCAN

Advisor: Dr. Kiser

FLORIDA SOUTHERN
COLLEGE

1948

1. Name: An enquiry into the availability and use of Atlantic marine fauna at, or near, the mouth of the St. Johns River, Florida, suitable for illustrating courses in zoology at Florida Southern College.
2. Location: Mayport, Florida, and nearby coastal waters, and Zoology Laboratory, Florida Southern College.
3. Duration: Project to be completed not later than the end of Pre-Session, Summer, 1948.
4. The Problem: The purpose in this investigation is to determine to what extent it is feasible to attempt to collect marine biological specimens to supplement land and aquatic specimens collected by students in S 411-431 (Field Zoology).
5. Specific Problem: To determine which selected species forming each phylum are suitable for preservation by drying and mounting, or in alcohol, or by other suitable means; to ascertain to what extent it is practicable to attempt to show physiological processes, such as autotomy and regeneration of parts in echinodermata, by use of several specimens of the same or related species.
6. Terms: The term "invertebrate" is used in the sense of animals lacking a rudimentary or developed notochord or vertebrae. "Marine" is used to mean oceanic salt waters adjacent to land as distinguished from "pelagic" and abyssal.

7. Delimitations: The specimens collected must be: (1) small, (2) found in salt water at, or near, the mouth of the St. Johns River, Florida, (3) easily preservable without necessitating expensive methods, (4) suitable for use in systematic teaching at Florida Southern College rather than those of a dilettante collector.

8. Basic Assumption: It is assumed that specimens representing each of the phyla having a temperate or sub-tropical habitat may be secured with sufficient persistence, and that these specimens may be useful in teaching a section or phylogeny in systematic zoology.

9. Need for Study: The acquisition of specimens which will be based on pedagogic needs rather than the whims of a collector is an expensive proposition if undertaken through usual biological supply houses. The experiences of Florida Southern College have shown the value of field courses in obtaining such specimens. The collecting of marine specimens cannot be undertaken by the ordinary class, but may be carried on by a single student or a group of students living near coastal waters. There would seem to be a real need for properly mounted, classified, and labeled specimens at the college.

10. Incidence of the Problem: The applicant has collected specimens privately for use in teaching high school biology for a period of more than three years. During the summer of 1947 she took a course at Florida Southern College in

comparative anatomy, and noted that there were few marine specimens at the college.

11. Related Literature: It is proposed to consult the reports and monographs issued by marine biological laboratories such as those at Marineland, Florida; Miami, Florida; and at other Atlantic locations. Publications of the Smithsonian Institution, The National Geographic Magazine, and the U. S. Bureau of Fisheries would also be consulted.

12. Procedure in Collecting Specimens: (1) In cooperation with my advisor, and such other members of the faculty as the Committee may determine, to draw up a "want list of types of material needed by the college. (2) Arrange to make regular weekly trips on fishing vessels, such as shrimp boats and other vessels engaged in marine extractive industries. Specimens would be secured through persistent sorting of the contents of the nets. (3) Shells or crustaces to be secured from littoral sites only to the extent desired by the college. (4) Specimens to be placed in mountings suitable to the individual specimens, such as cotton or plastic. (5) Specimens not suitable for other types of preservation to be placed in alcohol with added amounts of formaldehyde and shipped in jars to the college. (6) Each specimen to be labeled as to the exact date and site. (7) Classification will be carried on in accordance with accepted works on systematic zoology and procedures were used by U. S. governmental agencies. (8) All specimens which will fit into the work of zoology courses now given or contemplated by Florida Southern College will be

given to the Zoological Laboratory of the college.

13. Bibliography: To be supplied at an early date, after communication with experts at marine biological laboratories.

14. Education: Georgia State Women's College (University of Georgia System); University of Alabama, with major in chemistry and minor in biology, 1929-31, (Undergraduate and Graduate work): Florida State University, SS 1934; Florida Southern College, SS 1947.

15. Degrees: B. S. in Education, University of Alabama, January 1931.

16. Professional Experience: Teaching biology, chemistry, and general science for fourteen years at Jasper, Live Oak, and Jacksonville Beach, Florida; Assistant State Oil Chemist, Tallahassee, Florida 1944-45; Research chemist for Tennessee Eastman (Kodak) Company for about one year, 1943.

17. Member: Duvall Education Association
Florida Education Association
Florida State Historical Society
Florida Archelogical Society
American Chemical Society
Central Association of Science and Mathematics Teachers, Inc.
American Association of University Women
Civic Music Association

18. Research: Research in chemistry on ramie by request of the State Department of Agriculture; Research in explosives (R D X), and (Trinitrotoluene) at Tennessee Eastman.

CHAPTER I

PROLEGOMENA

The Problem

General Statement

As Florida Southern College had relatively few supplementary specimens of marine fauna, the purpose of this investigation was to determine the possibilities of making a collection of marine biological specimens from the waters near the mouth of the St. Johns River. Should this collection become a reality, it would show the relative value of the various specimens in the teaching of zoology and general biology at Florida Southern College.

Specific Problem

The specific problem was to determine which of the species would be the best suited for preservation in the different preservatives. These preservatives would be alcohol, formaldehyde, or plastic. The physiological processes of autotomy and regeneration are interesting to observe, and this was to be shown by the use of more than one specimen of a species.

Definition of Terms

The term "invertebrate" is used to mean animals lacking a rudimentary or developed notochord. "Autotomy" means the reflex act of throwing off a limb or surrendering a portion of the body following the effect of an external stimuli. "Marine" is under-

stood to mean the oceanic salt waters adjacent to land. This is distinguished from "pelagic" which is that section of the sea extending from the low water mark to one hundred fathoms in depth. "Abyssal" is the depth from one hundred to two thousand fathoms.

Delimitations

In the collection of specimens to be presented to Florida Southern College, certain delimitations were made. All of the specimens had to be (1) found in the waters surrounding the mouth of the St. Johns River; (2) small enough to be preserved in the specimen bottles provided by the college; (3) easily preserved without the process of expensive preservatives; (4) invertebrates; (5) suitable for illustrating various zoology courses at the college in which marine fauna is an important part; or in teaching a section of phylogeny.

Basic Assumption

It was assumed that enough specimens could be obtained to make a satisfactory collection if weather conditions, and fishing conditions permitted the shrimp boats to go out to sea. A collection of this type could be made if sufficient persistence and initiative were employed by the collector. It is also assumed that the specimens taken would be found useful in teaching physiological processes or phylogeny in the invertebrate zoology.

Basic Hypothesis

It was supposed that the various specimens would be secured from the ocean by means of the shrimp nets; that the specimens would vary with the seasons; that the spawning habits of the different species might determine the daily catch; and that,

with all difficulties taken into consideration, there would be sufficient specimens for an interesting collection showing the availability of material and suitability of such a study.

The Need for the Study

As Florida Southern College is too far inland to undertake class work in marine biology, it seemed that a collection of marine invertebrates would be an excellent supplement to the zoology laboratory. The work of such a project would need be undertaken by an individual in the proximity of costal waters accustomed to the methods of collecting, and not to inadvertant methods. The collection would need be based on systematic teaching for it to be of value to a laboratory. Thus there would be real need for a systematic collection of marine invertebrates, properly mounted, labeled and classified.

Incidence of the Problem

During the summer of 1947 the applicant took a course at Florida Southern Collect in comparative anatomy. While working in the zoology laboratory she noted that there were no supplementary specimens of marine invertebrates. Becoming interested in obtaining some for the college she suggested that a project might be undertaken and a systematic and helpful collection be made. The applicant has collected specimens from boats and from littoral sites for three years and owns a diversified collection of marine fauna. Most of this collection is used in the systematic teaching of high school biology and in sectional teaching of general science. The applicant has found collecting a fascinating occupation and enjoys any work done in this field.

Related Literature

Bulletins of the Department of Agriculture of the State of Florida and the United States Bureau of Fisheries were examined as were the reports of the Smithsonian Institution. In addition many copies of The National Geographic Magazine were reviewed in search of the types and species of invertebrate fauna found in the waters surrounding the mouth of the Saint Johns River, Florida.

Procedure in Collecting Data

The collecting of marine specimens for this project was carried on chiefly during the months of April, May, and June, 1948. During these months the weather was fair and visitors were permitted on the shrimp boats. All specimens that have presented to the college were taken by net from the waters at, or near, the mouth of the Saint Johns River between one half mile to one and one half miles distance off shore. This project was made possible through the kindness of Mr. Mithias Roland, the fleet owner; Captain Tony Souza, the captain of the shrimp boat; and the two very kind deck hands.

CHAPTER II

DIFFICULTIES

Many difficulties were encountered in securing specimens for this project. Due to a full teaching schedule it was impossible for the author to make trips on the sea aboard the shrimp boats except on Saturdays. Occasionally these days would be governed by stormy weatner or overcast skies and the shrimp fleet would remain in port. In addition to this, the shrimp fishing season was closed for a few weeks during these months to permit spawning and the hatching of the young shrimp.

In order to make a trip with the shrimping fleet, one must be at the dock between 4:30 and 5:00 A. M. The boats remain at sea the entire day or, at least, until mid-afternoon. For a project of this type to be adequate a great deal of time must be spent as it will vary with the seasons. To make a really complete collection, from two to three years should be spent in obtaining specimens. Time and effort are of no concern, and sunburn and other frequent personal discomforts are a part of the work. This is no place here for a "weak stomach" or squeamish nature. At all times care must be taken in order to avoid nipping by the Blue Crab (Callinectes sapidus), one of the most vicious members of the crab family. Another source of danger of an unsuspecting nature is found in the nematocysts on the gastric tentacles of jelly-fish (Pelagia cyanella). These stinging cells can cause much pain but not nearly as much as the tentacles of the Portugese-

man-of-War (Physalia pelagica). This latter, a beautiful, irridescent blue creature, is one of the most deceptive and dangerous of marine animals, an excellent example of the kindness of nature in giving brilliant coloring to well-defended species. Thus man can see the delicate tinted rufile at a distance and can heed the danger therein. A broken tentacle of one of these animals, entangled in a mass of fish, crabs, and shrimps in a net, if touched by any part of the body could send the collector to bed for a day or so with the most severe pains from swollen lymph glands.

Care must also be taken in handling specimens having spines. These creatures, frequently appearing to be dead, sometimes come to life quickly upon being touched. Needless to say then, it is a prerequisite that the sea and the marine life therein hold a definite appeal to an individual or collecting of this nature would surely prove a loathsome task.

Thus cautionary measures must always be heeded and by the beginner this advice must first and foremost in the mind. A few suggestions wise to follow might be listed:

(1) Observe a specimen for several seconds before lifting it from the deck. Never act impulsively.
(2) Lift all specimens, whenever possible, with a gloved hand before touching them with the bare hand.
(3) Deposit the specimen selected carefully into a bucket containing sea water.
(4) Do not overload the specimen bucket. Many specimens are very delicate in structure and will tend to disintegrate if too closely packed.

Aside from the difficulties encountered in securing the specimens, many other factors hamper the collector's ardor and efforts. One of the most troublesome of these is the selection and obtaining of satisfactory liquid mediums best suited to the

various types of marine fauna secured. For the most part, formaldehyde is usually used because it is the least expensive. However, this preservative has a decided tendency to bleach many of the specimens. It is also noted that there is considerable sloughing of epithelial tissues when the formaldehyde solution is of sufficient strength to satisfactorily prevent decomposition. On the other hand, a ten percent solution of formaldehyde will keep specimens pliable so that they will have a more natural outward appearance even though the delicate coloring and design may be partially obliterated.

A seventy percent solution of ethyl alcohol is, perhaps, the most desired preservative. In this the colors of the animals will be clear and bright though the body tissue will likely be hardened. However, due to government regulations, this could not be obtained cheaply because of the prohibitive bond required. Then in addition to this, the local biological supply houses could not obtain substitute products at the time and all the alcohol that was used was some type of the "rubbing" alcohols on the market. For the most part, the formaldehyde was used. However, as soon as satisfactory alcohol can be had, the author plans to continue with this work privately until an effective medium can be established for each individual specimen.

Bio-plastic, which is still in the experimental stage, was used with very small specimens and is effective though it is entirely too expensive to be used in general. Mounting this project in plastic would have cost the collector at least fifty dollars. It is an excellent medium for fragile specimens injured by liquid preservatives. From the storage standpoint, it is certainly much

more convenient to store blocks of plastic than bottles of liquids. However, for manual examination, specimens preserved in a liquid are more effective as students learn rapidly by handling the actual specimen. Nevertheless, plastics will find a place in the laboratory for they will make an excellent supplementary section for any of the animal phyla.

Not only are there losses from preservatives but there are, also, losses due to accidents. Marine animals are very perishable and decomposition sets in quickly after death. It is impossible to keep the specimens to be preserved in a dry state in the house during the drying process. The gasses given off by the decaying protoplasm of the organisms have a distinctly characteristic odor. Thus the specimens are dried out of doors. Even then the strong, pungent odor of decomposing marine protein pervades the entire neighborhood until it smells like a fish meal factory. The author, at the completion of marine collecting projects, always hopes that she still holds the good will of her neighbors.

While the specimens are drying in the sunshine they become a novelty for the youngsters of the neighborhood. Their curiosity knows no bounds and they always want to see and touch all drying or bottled specimens. In this process of examination a specimen is frequently broken because of its fragile shell.[1] Others will just "accidentally disappear" into the pockets of the young fanciers. Yet knowing all this, the author never forbids the children

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1. I remember quite clearly, upon coming home from school one afternoon, finding my drying specimens out of order and my only Lytechinus variegatus (one of the sea urchins) smashed into bits. I knew immediately that my young friends had preceded me home.

the pleasure of watching her work or never tires of explaining to them the actions and characteristics of the various animals.

Accidents also occur aboard boat. The deck hands occasionally forget and throw overboard specimens that were to be kept. This is always unintentional for these men are usually very helpful and kind. They will gladly extract any specimen requested out of the catch though they are busily engaged in heading the shrimp. When told the species particularly needed they will hand over each of these as they come to them until told to stop.

After the specimens are collected and preserved the classification must be done. Here is a real difficulty for which there is no immediate solution. Each taxonomist has his own particular classification and frequently they do not agree with each other. Thus sources of information may vary as to the nomenclature of certain species as there is no standard of conformity. Certainly there is a great need for a detailed taxonomy of southeastern marine animals and an agreement on these by the taxonomists of today.

CHAPTER III

GENERAL PROCEDURE

At this point the author would like to visualize for the reader a typical expedition to the shrimp beds with the shrimp fleet; explain in detail and sequence the many interesting points of collecting; and show the relative value of the various specimens in the teaching of general biology and zoology.

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A heavy, low fog, which continually deepened as we drove northward, hangs along the beach road. Though it is early May, we need light jackets to keep out the morning dampness and the light breeze which intermittently comes in gusts as we approach the St. Johns River. Mayport, the quaint old fishing town built on the site of the first French settlement and the scene of the Spanish massacre of Jean Ribaut's colony, is our destination. This interesting little village lies inland about two or three miles on the south bank of the St. Johns. The mouth of the river, once wide and marshy, has been narrowed by the construction of jetties on both sides of the stream, and the channel is frequently dredged to insure the necessary depth for the ocean going vessels plying the river to Jacksonville.

Before the advent of the shrimp as a popular seafood, the fishing fleet at Mayport took chiefly snapper, grouper, trout, and mackerel from the coastal waters. With an increasing demand for

shrimp, the fleet installed regulation shrimp seining equipment. During the past thirty years, thousands and thousands of dollars have flowed into the channels of trade from the sale of the large prawn as well as the small shrimp which spawn prolifically in the nearby waters. Many fishermen and their families have moved from the New England coast southward. A number of these were Portugese. In some instances the migration was directly from New England to Mayport, while in others it came about by means of stop-overs at other ports. Brunswick, Georgia, and St. Augustine, Florida, being larger centers, served as distribution points for many Portugese families. In a few instances, however, the Portugese came to Mayport directly from Portugal.

The distance from Jacksonville Beach to Mayport is from seven to ten miles. Inhabitants of the beaches see the shrimp fleet trolling their nets on fair days, up and down the coast from south of Jacksonville Beach to a distance of a mile or so north of the mouth of the St. Johns; but few of these people have ever been out with the fleet. Little do they know of the contents of the net hauls and the interesting marine life which exists just off shore.

After our eight mile drive north through the fog to Mayport, our small party arrives at scheduled time at the Roland Shrimp Company located at the Roland Dock about the middle of the dock section on the riverfront. There we wait briefly for our captain to arrive. The deck hands, two heavy set negro men, are about their business of readying the boat. Just as we were about to feel the chill of the early morning dampness, the captain, Mr. Souza, a small Portugese gentleman, weather-beaten, surn-browned, and wrinkled, arrives and together we walk out on the wharf and

step down onto the boat deck for it was then low tide.

Shrimp boats usually range in length from forty to sixty feet. The width of the stern will be proportional to the length; a sixty foot boat will have a stern about fourteen feet wide.

In a few minutes our motor starts and we are on our way eastward into the dawn, with a crisp wind in our faces and a surge of excitement in our thoughts. We become a part of the shrimp fleet. In front of us and behind us are boats. As we pass nearby wharves we hear the sounds of other motors. Their crewmen call and wave to us. Gulls circle overhead. A pelican swoops downward to pick up a stray fish for his breakfast. The tang of salt in the air adds to the spirit of adventure. We pass Fort George Island, the site of old Fort Caroline, on the north bank of the river. Now the jetties are almost behind us, and to our right we see the lightship, which is used in lieu of a lighthouse. As we enter open water the gray dawn grows lighter and the golden disc of the morning sun breaks through the smooth sea, dispersing the adhesive, ubiquitous mist and sending out brilliant lights through the myriads of water droplets. Truly there is a song in the air as we view the quiet radiance of the morning. We knew at this moment how John Masefield must have felt when he wrote his immortal "Sea-fever":

> "I must go down to the sea again, for the call of the running tide
> Is a wild call and a clear call that may not be denied;
> And all I ask is a windy day with the white clouds flying,
> And the flung spray and the brown spume and the sea gulls crying."

Now the harbor is cleared and the last buoy passed. Our boat turns to the south and we now lie over the continental shelf where the shrimp beds are. We begin the serious business of the day.

The small cylindrical net, about four or five feet long and approximately eighteen inches wide, is thrown overboard from the port side of the aft deck. This is trolled for twenty or thirty minutes and then hauled in to check the contents. In good shrimping territory the catch shows about fifteen percent shrimp. If this percentage of shrimp is low the test net will be cast out again in an effort to locate better shrimping grounds. Shrimp fishermen in the southeastern section of the United States are more interested in the prawn (Penaeus setiferus) which is a full grown shrimp. This larger shrimp brings a higher market price and, of course, it takes fewer to weigh a pound. Shrimp marketing to the east and middle west is carried on chiefly by means of the very large refrigerator trucks.

Granting that the second haul of the test net is satisfactory, the deck hands ready the large net for casting. This net is about four feet in diameter and approximately seven or eight feet in length. Though the test net fails to yield a profitable percentage of shrimp, the large net will be cast at least four or five times during the day.

The casting of the large net is done with a boom. About seventy-five feet of steel cable is unrolled so that the great net will lie on the bottom of the ocean. Here it is trolled for about an hour and a half. Twelve inch rows of hemp fringe, attached to the under side of the net, prevent it from catching on rough rock ledges that rise from the ocean floor.

During the interim between the casting and the intaking of the great net, the deck hands "catch a nap". The passengers may sleep, read, sun bathe, or watch for marine fauna that may float

or swim by. Frequently large masses of jelly fish (usually Stomolophus meleagris, the Root-mouthed Jelly-fish) are encountered, drifting along in schools. This species is too large for collecting as the average diameter of the umbrella is from eight to twelve inches. The S. meleagris is carried by the Gulf Stream and is found from the Carolina coast to the West Indies.

Always interesting to watch are the porpoises. These cheerful, frolicking animals are in constant attendance, always expecting a "hand-out" from the catch for their appetites never seem to be satiated. Occasionally, in the distance, we may see the dorsal fin of the sand shark or his cousin, the dreaded man-eater.

The minutes tick away as we wait impatiently for the time that the great net will be drawn in. Finally time is up; the capstan motor is started; the heavy steel cable winds around the windlass; and out of the sea rises a net bulging with writhing, squirming marine animals.

As soon as the cable is made fast, the boom swings the net to the center of the broad aft deck; a deck hand unties a slip knot; and the bottom of the net is opened, spilling all the seething, jumbled, unhappy catch onto the deck.

At that instant excitement really begins, and to the novice, it begins in a hurry, for the Blue Crab (Callinectes sapidus), in all sizes from an inch and a half to twelve inches and fighting mad at having been distrubed and evicted from his home, dashes up and down deck in an attempt to find an escape outlet. Brandishing his large pincers, he dares anyone or anything to halt his backward progress. Once he is cornered, he is a most

difficult creature to catch for his pincers are dangerous and, as he fights with his back to the wall, it is impossible to grasp him by the posterior end which is the focal point for capture. This beautiful blue crustacea proves a worthy problem to outmaneuver, for in this frame of mind he cannot be appropriated without injury to himself or the collector. It is best, therefore, to select the specimen desired and wait until he is quiet before attempting to capture him.

Just before the net is opened I usually find some clear spot on the closed hatch and turn a water bucket upside down to use as a seat. When the net is opened and the dozens and dozens of crabs scatter all over the deck, it is wise that the collector becomes not too interested in the catch to forget his or her own personal welfare. Some of the species are large and vicious and can give a most painful nip to an exposed toe or ankle.

The Blue Crab is the edible crab of commerce.[2] The deck hands pick out the largest specimens and toss them into a heavy wire basket. On the homeward trip these will be taken to the crab house where they will be cooked by being dropped alive into pots of boiling water. Following the cooking the crabs will be shelled and the meat packed in unsealed metal cartons for the market. Crabmeat packed in this way has to be kept frozen to

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2. This is the crab that is most familiar to the average person. Since "deviled crabs" are a favorite dish of so many people, one seafood concern now packages four Blue Crab shells with a tin of canned crabmeat. Crabmeat when sealed will remain fresh indefinitely. Heat causes the shell of the crab to turn a reddish orange color. Many housewives, unfamiliar with the characteristics of marine animals, mistakenly think that the red shell of the crab is its natural color.

prevent spoilage. Thus the cartons are immediately transferred to refrigerated storage houses or trucks.

C. sapidus is easily identified by a long-sharp spine on each side of his shell or carapace, and eight short spines between the long spine and the eyes. The carapace is about twice as broad as it is long; the eyes are set in recesses or depressions; and there are four unequal teeth and a small spine underneath. This crab has five pair of legs or chelipeds, the first pair of chelae (feet) bearing large pincers; the second, third and fourth pair being the walking organs; and the fifth, the flattened, paddle-like legs used in swimming. The abdomen of the female is very broad, filling the entire space between the posterior feet. During spawning season she holds her eggs firmly to her body by means of the shield-like abdomen. This egg mass, or "sponge" as it is known to the fishermen, continues to be held until laying is completed. So prolific are these crabs that the egg mass causes the shield to extend out at right angles with the carapace.

As the crab grows, the hard blue shell does not grow with it, and in the course of time the shell becomes too tight and uncomfortable for it.[3] Thus the shell splits, moulting occurs, and the crab, soft and unprotected, crawls out. C. sapidus at this

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3. F. W. Flattely and C. L. Walton, The Biology of the Sea-shore, pp. 90-91. In this work the two biologists quote from W. A. Herdman (1907) to the effect that fishermen at Port Erin, British Isles, apply the term "granny crab" to the crabs which have a worn, dilapidated carapace. Such crabs frequently have barnacles on the great claws and the shell. In the British Isles these are found in July and August just before moulting which occurs every two years.

stage is the soft-shelled crab, which makes an especially delicious food. Gradually the shell hardens and the story is repeated. The Blue Crab is very common from Cape Cod to Florida.[4]

Next in importance to the Blue Crab[5] is the colorful "leopard", "striped", or "spotted" crab by which names it is known on the waterfront. This is a southern species of the Jonah Crab (Cancer borealis). Spots or figures of brick red stand out on the cream-colored background of the carapace and chelipeds. This species varies in size from one to four inches in width. It is a very active animal though it reacts to danger in the opposite manner of the Blue Crab, for instead of fighting its captors, the Jonah Crab shows a sudden, complete cessation of activity and appears to be dead. This is a form of animal hypnosis existing also in some snakes, opposums, horned toads, and stick insects. Thus the Jonah Crab is easy to capture and any specimen seen in the catch may be had with little effort or danger.[6] Though some taxonomists list this crab as unusual south of the Carolina coast, Richards[7] mentions that it is found in deep water as far south as Florida.[8]

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4. Horace G. Richards, Animals of the Seashore, p. 235.
5. The collector mentions this species first in the paper for several reasons: (1) It is pugnacious and will attack anything in its path. (2) As various species of crabs compose about one half the catch, and the Blue Crab in turn makes up two-thirds of this bulk, it is listed thus on account of its abundance. (3) This is the best known species and should, therefore, be more interesting to the general public.
6. Richards, op. cit., pp. 238-9
7. Richards, op. cit., p. 239
8. The collector found that this species existed in large numbers along the continental shelf in water from ten to twenty fathoms deep and was second in abundance in every haul of the net. This crab is so irregularly marked that a young collector, seeing it for the first time, would never forget it.

Aside from the Blue Crab and the Jonah Crab, the other members of this order are also netted in small numbers. The large Hermit Crab (Pagurus pollicaris)[9] is found in practically every empty shell of Polinices duplicata. It is an excellent commentary on the continual struggle for existance that the discarded, outgrown armor of mollusks can be used as houses by complete strangers. This habit of lying concealed within a Gastropod shell has continued for so many ages that it has become so deep rooted as to have profound effects upon the structure and behavior of the Paguridea. Each hermit adapts itself to the shell which it inhabits. Thus one individual will vary from another according to the species of shell house that it selects.[10]

With the passing of time, the abdomen of the Hermit Crab has so degenerated that it has lost its hard covering and has become spirally wound so as to fit the convolutions of the shell it inhabits. The attachment of the crab to the shell, by means of the last pair of modified, hooked appendages fastened to the columella, has become so secure that only the crab can remove itself from the shell without injury to its gelatinous, degenerated abdomen. The posterior segment hairs enable the female to hold the eggs until they are hatched and the young hermits can pass out of the shell and swim into the sea to find homes of their own.[11]

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9. Augusta Foote Arnold, The Sea-beach at Ebb-tide, pp. 258-9. Though the Paguridea are called crabs, they are not of the suborder Brachyura but are of the suborder Macrura. The Brachyura are characterized by a broad, flat thorax with the abdomen bent under the thorax to form a kind of abdominal shield. The Macrura, on the other hand, has a more or less cylindrical body with abdomen extended. In moulting the latter splits in a longitudinal line dorsally; the former, horizontally below the thorax.
10. F. W. Flattely and C. L. Walton, The Biology of the Sea-shore, pp. 103-4.
11. Arnold, op. cit., p. 265

Of the five pair of anterior appendages, the large chelae of the first legs are used for gathering food and for protection. The second and third pair of legs are for walking and dragging the crab and his appropriated house along. Seemingly encumbered as they are, these crabs can move very rapidly. The atrophied fourth and fifth pair are all that remain of what would have been strong swimmerets. Thus through retrogression these animals have become walking crabs.[12]

When the hermit crab grows too large for his shell home, he begins to search for a larger one. Finding an empty shell he probes the interior of it carefully before making a change. Once his decision is made, he affects the change so quickly that it looks to be a sleight of hand performance. The posterior hooks are loosened from the columella of the outgrown shell, slid into the new shell, and secured. In the event that hasty judgment has been necessary and the new house is not large enough, the hermit must again go out reconnoitering until a comfortable fit can be found. On these house hunting expeditions, should two crabs with similar intentions meet, a fight will ensue until the one or the other is evicted. Should the mollusk shell that a hermit inhabits come in contact with and be attached to a colony of sea anemones (Epizoanthus americanus), the anemones will eventually absorb the shell and the hermit will live in commensal happiness within the protection of the colony, never more having to go out in search for a house to care for his expanding abdomen.[13]

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12. Arnold, loc. cit.
13. Arnold, op. cit. pp. 266-7.

In the net will also be seen an occasional Spider Crab (Libinia emarginata or Libinia dubia) usually covered with hydroids, sponges, or algae so that, in his effort at camouflage in the ocean mud, he has become, indeed, an untidy appearing individual. This crab ranges in size from one half inch to ten inches and is covered with either sharp or blunt spines. The spiny carapace serves as an excellent protection from his enemies. Though startling in appearance, the Spider Crab is really harmless for the chelae are no more than walking legs and not dangerous pincers. It will live frequently as a commensal within the tentacles of a jelly-fish.[14]

Another of the Portunidae brought into the net is the Lady Crab (Ovalipes ocellatus). This is the same family as the Blue Crab and the dispositions of the two are somewhat similar. The Lady Crab's coloring is similar to the Jonah Crab in that its carapace and legs are covered with red dotted rings on a white background. This species is very common from the shore to water as deep as twenty fathoms. All the specimens taken by the collector were out of the nets, though it also inhabits the sandy beaches and may be found at low tide buried in the sand just waiting for something to eat. Seeing a tempting object, the Lady Crab darts quickly from its hiding place, takes a nip with its sharp chelae, and retreats just as quickly beneath the sand and out of sight. The toe of an unsuspecting bather often becomes the object of such a sudden, unheraled nipping.[15]

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14. Richards, op. cit., p. 227
15. Ibid., pp. 237-8.

Other members of the crab family brought onto the deck are listed as follows:

(1) the Stone Crab (Menippe mercenaria) which is excellent for food because of its large pincers;
(2) the Purse Crab (Persephone punctata) an odd lodding individual with a globular carapace thickly covered with granules, and legs, angular like the Spider Crab and about its size;
(3) the Red Crab (Portunus spinimanus) having angular legs and being red-brown in color.

Of the shrimp in the catch, the large southern shrimp, Penaeus setiferus, will range in size from three to eight inches. The size of the shrimp, as well asany of the crustacea mentioned, depends upon the age of the animal. The large, full-grown members of this species are referred to as prawns while the small ones are shrimps. Prawns are known as crevettes in France and as Garnelen in Germany where they are used as food just as in the United States. This shrimp does not occur in sufficient numbers north of Chesapeake Bay to make it of commercial value.[16]

To me, the antennae of this shrimp is interesting. It is from a foot to a foot and a half long and it is remarkable how the prawn can mannage it without becoming entangled. When these little swimmers lie on the hot deck it is pitiful to watch their futile efforts to escape. The soft swimmerets will work so frantically in an attempt to lift the heavy body. So it is that the swimmers have no means or escape when out of water and are at the mercy of the new environment, finally dying because no adaptation can be made. On the other hand, the walking-swimming crustacea of the Brachyura, having both adaptations to water and

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16. Arnold, op. cit., pp. 259-60.

land, finds himself at home in either place and can protect himself adequately from marine or terrestrial enemies.

The second variety of shrimp, the Mantis Shrimp (Squilia empusa), is not a true shrimp. It belongs instead to the order Stomatopoda of which it is the only member. The coloring of this oddity is of the same gray as the Southern Shrimp, though it resembles a small lobster.

The Mantis Shrimp is truly named for it resembles so much the mantis of the insect world. There is a long flat abdomen, a broad telson or caudal fin, and chelae onthe front feet which are divided into six sharp, curved spines with which it grasps its food by pressing the chelae against a groove in the second joint. It is these sharp pronged chelae which are always raised that give the likeness between the Mantis shrimp and the mantis insect. This species is usually from four to eight inches in length and is not considered edible.[17]

In sorting over the catch we have now collected specimens of all the various types of Crustacea found. Before all the starfish have been damaged or pushed overboard with the waste,[18] we must try to select enough of one species to show satisfactorily autotomy and regeneration of parts. Three types of starfish can be picked out. This must be done before the star dies if a

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17. Arnold, op, cit., p. 288.
18. After the shrimp are taken out of the catch and the large crabs and all other edible species, the remainder is thrown overboard or pushed out through openings on the deck. Frequently the catch will show a large number of flounder, an excellent food fish which lies on the bottom. Sometimes there will be trout and other small edible fish. Squids are picked out if they are large enough to be worthwhile. About one half of the catch is returned to the sea.

regular alignment of the arms is desired. The stars may be handled without injury to the skin. Specimens selected will be: (Astropecten articularis), in the smooth, blue bordered star; (Luidia clathrata), a smooth gray star; and (Asterias Forbesi), the abundant rough orange star. For some reason, perhaps because it may be a little more brittle, there always seems to be more repair work going on with A. articularis. It will be easier, then, to show autotomy and regeneration with it. To those who are not familiar with the first term, Flattely and Walton explain autotomy as "the term applied to the reflex act of throwing off a limb or surrendering a portion of the body in relation to some external stimulus."[19] Most people are familiar with the lizard who breaks off his tail when seized by it. However, they are not conscious of the fact that he throws off this tail at a level which corresponds to that of the seventh caudal vertebra, an area especially weakened by nature for this purpose, Just as the lizard leaves his tail in the hands of his would be captors, so the prawn will lose a leg; a crab or lobster, a chelae; and a starfish an arm. The prawn's leg will fall off at the joint between the second and third segments while the Brachyura, or true crabs, will lose a limb at a definite breaking plane located in the middle of the second segment from the base, and marked externally by a ring-like groove. It is here that autotomy reaches its highest development.[20] In the Echinoderms, self-amputation is more widely distributed but the level is not definite. Starfish lose one or more arms easily. About one tenth of the total

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19. Flattely and Walton, op, cit., p. 117.
20. Ibid., pp., 118-19.

number should show this action. Not only can the star lose an arm or so and regenerate substitute appendages, but it can grow an entirely new star if a part of the central disc is attached to the arm that has been lost. In a few species regeneration has been found to take place in the absence of any portion of the disc, though in the Forbesi and Vulgaris about half the disc must be left with the arm to have the regeneration of a new star.[21] This regeneration process will take place in any region, though the closer that the arm is severed to the disc, the more rapidly the new portion grows.[22] This explanation of autotomy and regeneration helps the collector to understand more thoroughly one of the normal phenomena of nature which is important to the individual animal as a means of propagation.

To the oysterman, however, the processes of autotomy and regeneration in the starfish are an economic liability. Starfishes are voracious feeders. In a few days a month old star can devour four dozen clams or oysters. With these bivalves, the starfish arches its body over the prey so that the tube feet can grip the opposite valves of the oyster and pull them apart. It can exert a continued pull of 1,300 grams, during which time the oyster's adductor muscles become tired from so much strain, for its resistance is only 900 grams, and the mouth opens widely. At this instant, the starfish everts its versatile stomach through its mouth, engulfs the oyster with a mucus secretion containing digestive enzymes from the pylorus and caeca, and then withdraws the bivalve and stomach back into the body. Large pieces of waste, such as shell, are dispelled through the mouth as the

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21. Ibid, p. 124.
22. Ibid, p. 124.

small intestines are reserved for fine waste.[23]

Starfish of the A. forbesi and A. vulgaris species are very destructive to the oyster beds, causing about two thousand dollars worth of damage in the United States annually. Truly their sense of smell must be very keen, as an oyster bed, free from stars one day, may be covered by the pests the next. Oystermen formerly were ignorant of the starfish's wonderful powers of regeneration and would cut up the starfish and throw the pieces overboard. Today the oyster fisherman sweeps a tangle, an iron bar carrying a rope drag, over the infested beds and gathers hundreds of stars at a sweep. The spines of the starfish are caught in the tangle and the captured stars are killed in hot water or carried ashore and thrown high on the dry sandy shore. Lime is sometimes sprinkled on the beds to kill the pests.[24]

Now that a sufficient number of starfish have been laid out to dry and others have been put into the specimen bucket, we might add two or three squids (Loligo pealei) to the collection. The squid is a member of the phylum Mollusca, class Cephalopoda. L. pealei has a cylindrical body that tapers to a point with a flat appendage in front and two terminal fins united in a posterior point. The head of the squid seems loosely attached to a part of the internal body, and slips in and out within the mantle, the upper part bearing the eyes and tentacles never retracting. The Loligo has ten arms or tentacles, and two of these are longer than the others, having suckers only on their broadened, club-like ends. These elongated arms are kept retracted in grooves

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23. Tracy I. Storer, General Zoology, p. 381.
24. Ibid., p. 381

on each side of the head and are used only for prehension.[25]

The squid is noted for its conspicuous eyes which are equipped with a cornea. It is white in color and covered with hundreds of red and blue pinpoint dots. Most of the specimens taken in the nets will range in size from three inches which are the young ones to eight inches, the adult.

The Loligo resembles a submarine boat and propels itself by a unique method of locomotion. This is done by means of stream of water that it squirts from a little tube near its neck. When it squirts forward, the animal moves backward. From this action the squid has gained the name, Rocket Animal, and it can move in any direction with equal rapidity. On the inside of the mantle is a pen- or quill-shaped cartilaginous substance which is really the shell of the animal. This has become so modified that it is now entirely within the body of the animal. The pen gives rigidity to the body and keeps it from being completely limp and flabby. The squid of the Mediterranean has a hard pen known in commerce as cuttle bone, a a favorite in the diet of canary birds as it furnishes lime and salts.[26]

The North Atlantic is inhabited by the Giant Squid which often measures fifty feet from the end of its arms (feet) to the tip of its tail. It is a powerful creature with huge suckers on its long tentacles and terrible jaws within the massive mouth. This is the dreaded "sea-serpent" of legend. The Giant Squid has only one natural enemy, the sperm-whale. This squid is not a native of Southern waters.[27]

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25. Arnold, op. cit., p. 460.
26. Richards, op. cit., pp. 196-7.
27. Arnold, op. cit. pp. 465-6.

As the deck hands[28] are picking out the largest squids to carry home, we ask the man nearer us how they are cleaned and prepared. Lifting one of the animals out of a bucket he makes a dorsal cut down the outer mantle and lays the internal part open to view in the palm of his hand. Here we see the ink bag with which the squid protects himself by coloring the water when in danger. This is the India ink of commerce. All the internal organs are scraped out and discarded, leaving only the flat mantle and caudle fins. Sometimes the head is also eaten. To cook, the flat piece of the mantle is dipped in a batter and fried in deep, hot fat.

There are a number of conch shells lying on the deck and we might select one each of the different kinds for our collection. Should there be energetic members in the party, they might take the largest, perfect specimens home and clean them of the barnacles, hydroids, and sponges inhabiting the outer part of the shell. We select the small specimens as they will fit in the specimen jars at hand. Two types were found, Fulgur carica, the Knobbed or Right-handed Conch, and Fulgur perversa, the Left-handed Conch. These univalves are the largest of the genus Fulgur, and will reach nine to twelve inches in length. The coloring of the shells of these mollusks is one of the most beautiful gifts of the sea. It is, indeed, worth the hours spent in cleaning[29] to have an exquisitely pink or gold tinted shell as a memento of a trip to sea!

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28. The colored deck hands are called strikers by people working in the shrimping business. Frequently young white boys work as strikers. The salary is based upon the value of the day's catch.
29. I clean the shells by pullihg out the dead conch and using sulphuric acid, about half acid and half water, to clean off the barnacles.

The conch as a part of the menu is served as conch steak, particularly in Key West, Florida, and one really has not seen the Keys until he has eaten conch steak, prepared and served by the natives of the Keys.[30]

One specimen only of the Sea-urchin, Lytechimus variegatus, has been found and just a few unbroken of the Arabacia punctulata. The former has very short spines, about one-fourth of an inch in length, while the latter has longer spines, often almost an inch long. The test, or shell, of these urchins will vary from an inch to two inches. This is in the form of an oval-appearing ball. The Sea-urchins move slowly about in the mud on the ocean bottom by means of tube-feet which extend out beyond the spines. As the spines of the urchin are brittle and very fragile, most specimens seen in the nets are usually badly mutilated. When preserved dry, the urchin appears with a smooth test as the spines fall off with handling. Children find the shells after storms, washed upon the sandy beach. The urchin lives in shallow water or down as deep as twenty-five fathoms.

Another of the Echinodermata that is common on the beach and in the nets is the Sand Dollar (Mellita quinquesperforata), or the Keyhole Dollar. This is superficially similar to the common sand dollar (Echinarachinus parma) but has five narrow keyhole-like openings (lunules) in the test instead of the solid unbroken disc of the E. parma. The sand dollars are badly broken in the nets due to their calcareous exoskeleton. The internal structure resembles that of the starfish. The Keyhole Dollar ranges in size from an inch to five inches in diameter.

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30. The natives of Key West are called "conchs", a name which many of them resent.

They are marked with a five pointed petaloid design on the dorsal side of the test, while the ventral side is covered with short spines holding tube-feet by which the animal walks its flat, discoid body through the ocean bottom sediment.[31]

There are no other invertebrate specimens that we can see. When the Hermit Crab was placed in the specimen bucket, the only anemone seen was one of the Actinia which lives on the shell house of the crab and which often is commensal with the crab. After the hermit is placed in alcohol the anemone will become loosened and can be placed in a jar by itself.

Needless to say, we are hot and tired by this time and ready to go home. Our effervesence of the early morning has gradually disappeared with the heat, the slime, and the work. There is a very tired feeling between the shoulder blades. Our clothes smell of sea life and sweat. The scarf, neatly tied in the morning, has fallen off and been shoved back on the head a dozen times. Our faces are red and almost blistered. We breathe deeply and straighten our tired backs and stiff legs. It is rather a relief to see the net hanging high for drying. The deck hand draws a bucket of fresh sea water and we wash off the dried slime, sand, and broken pieces of shell that have become stuck to face, arms, and legs. The stewed steak which one of the negro boys cooked for us at six o'clock in the morning is all gone as are the sandwiches and cookies that we brought with us. The shrimp which we boiled and ate like peanuts are no longer with us and our stomachs are very empty. What a day!

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31. Richards, op. cit., pp. 89-91.

As the boat heads west, we "hit" the deck or the bunks. There we lie motionless for many minutes and just relax and daydream. It has been a wonderful trip; lots of work but lots of fun, too. The sun and soft breeze make us sleepy. We look toward shore and see that we have passed the jetties. The navy base is next. Then we dock at the crab house and colored boys on the wharf help lift the crab-filled baskets from the boat. The next stop is our dock so we get up and begin gathering together our assorted paraphernalia which has become scattered during the day. Now the boat scrapes easily against the dock. With arms loaded with jackets, lunch baskets, thermos bottles, large conchs, odd shells and the specimen buckets we step from the deck to the wharf. Our host, Mr. Roland, smiles and greets us as we enter the shrimp house. A few colored women are heading the small shrimps at the wooden troughs. The shrimp brought in by the other boats are in the big bin being washed, or are being packed in crushed ice to be sent to market in the large truck that waits just outside. The boat captains sit around and laugh and talk--in Portugese. A cat walks around our legs but carefully watches a couple of small fish on the top of a box. The large, fight-scarred watch dog sleeps apart from the unloading activity. Our captain comes in from the boat and we thank him for the trip. It is time to go so we say goodbye to Mr. Roland and get into the car. As we drive, again along the beach road, this time southward, we drive in comparative silence. Each one seems to be absorbed in his own meditations, recounting mentally interesting flashbacks of the day at sea. Another block and we are home. We have had a different day.

CHAPTER IV

SUMMARY AND CONCLUSIONS

To summarize the project it can be stated that an abundance of marine fauna was gathered from the shrimp nets of the shrimp fleet. This material was varied and interesting in that it did not duplicate material owned by the college. The various species obtained can well be used in teaching Zoology at Florida Southern College as it makes a supplementary collection for the Zoology Department. There were seven species of crabs presented and the differentiation between each of these species should prove interesting to students of Systematic Zoology.

The methods of collecting and the dangers therein were explained in detail so that a beginning collector should have little difficulty in making a systematic collection. All of the ordinary difficulties encountered in procuring such a collection were elaborated upon as well as the many disagreeable conditions that surround working with marine fauna.

In concluding remarks about collecting marine specimens, it can be said, that for an individual who is interested in animals of the sea and sea-shore, a project of this nature is fascinating. The collector becomes so absorbed in each successive haul of the shrimp net and the probable specimens that it may bring, that heat, sunburn, sweat, flies, and dirt are all forgotten. On the other hand, if the would-be collector has an aversion to discomfort and

work, a marine collecting project would be foolish to attempt. In addition to this, if sea-sickness is incurred by the collector upon the first trip, the project might well be abandoned as little pleasure could be derived from it.

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Appendix

The following is a list of the specimens collected:

Phyla: Coelenterata, Order: Actiniaria;
Species: A. Actinia (Sea Anemone)

Phyla: Echinodermata, Class: Asteriodea;
Species: Astropecten articularis (Blue-bordered Starfish)

Phyla: Echinodermata, Class: Asteriodea;
Species: (Luidia clatharata (Neutral-gray Starfish)

Phyla: Echinodermata, Class: Asteriodea;
Species: Asterias forbesi (Common Starfish)

Phyla: Echinodermata, Class: Echinoidea;
Species: Arbacia punctulata (Purple Sea Urchin)

Phyla: Echinodermata, Class: Echinoidea;
Species: Lytechinus variegatus (Variegated Sea Urchin)

Phyla: Echinodermata, Class: Echinoidea;
Species: Mellita quinquesperforata (Keyhole Dollar)

Phyla: Mollusca, Class: Gasteropoda;
Species: Fulgur carica (Knobbed or Right-Handed Conch)

Fulgur perversa (Left-Handed Conch)

Phyla: Mollusca, Class: Gastropoda;
Species: Polinices duplicata (Sea Snail)

Phyla: Mollusca, Class: Cephalopoda;
Species: Loligo pealei (Common Squid)

Phyla: Arthropoda, Class: Crustacea;
Order, Decapoda; Suborder, Macrura;
Species: Penaeus setiferus (Southern Shrimp)

Phyla: Arthropoda, Class: Crustaces;
Order, Decapoda; Suborder, Macrura; Family, Paguridae;
Species, Pagurus pollicaris (Big Hermit Crab)

Phyla: Arthropoda, Class: Crustacea;
Order, Decapoda; Suborder, Brachyura;
Species, Libinia emarginata (Spider Crab)

Phyla: Arthropoda, Class: Crustacea;
Order, Decapoda; Suborder, Brachyura;
Species, Persephona punctata (Purse Crab)

Phyla: Arthropoda, Class: Crustacea;
Order, Decapoda; Suborder, Brachyura;
Family; Portunidae;
Species, Callinectes sapidus (Blue Crab)

Phyla: Arthropoda, Class: Crustaces;
Order, Decapoda; Suborder, Brachyura,
Family, Portunidae;
Species, Portunus spinimanus (unknown)

Phyla: Arthropoda, Class: Crustacea;
Order, Decapoda; Suborder, Brachyura;
Family, Cancroidea;
Species, Cancer borealis (Jonah Crab)

Phyla: Arthropoda, Class: Crustacea;
Order, Decapoda; Suborder, Brachyura;
Family, Cancroidea;
Species, Menippe mercenaria (Stone Crab)

Phyla: Arthropoda, Order; Stomatopoda;
Family, Crustacea;
Species, Squilla empusa (Mantis Shrimp)

Date Due

DATE DUE	BORROWER'S NAME